Centers for Disease Control and Prevention
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Morbidity and Mortality Weekly Report (*MMWR*)

Early Warning Disease Surveillance After a Flood Emergency — Pakistan, 2010

Weekly
December 14, 2012 / 61(49);1002-1007

During July–August 2010, Pakistan experienced extreme flooding that affected approximately 18 million persons. In response to the emergency, Pakistan's Ministry of Health and the World Health Organization (WHO) enhanced an existing disease early warning system (DEWS) for outbreak detection and response. This report summarizes surveillance results early after implementation, describes system usefulness, and identifies areas for strengthening. Daily disease counts were reported from health facilities in four provinces containing 98% of the flood-affected population. During July 29, 2010–September 15, 2010, approximately 5.6 million new patient visits were reported. The most frequent conditions reported were skin diseases (18.3%), acute respiratory infection (15.1%), and acute diarrhea (13.3%). A total of 130 outbreak alerts were documented, of which 115 (88.5%) were for acute watery diarrhea (AWD) (suspected cholera). Of these, 55 alerts (47.8%) had at least one microbiological sample with confirmed cholera. Overall, DEWS was useful in detecting outbreaks, but it was limited by problems with data quality. Improvements in DEWS have increased system usefulness in subsequent emergencies. This report highlights the need to follow updated WHO guidelines on early warning disease surveillance systems to improve their usefulness (*1*).

Background

In emergencies before the 2010 floods, the Pakistan National Institute of Health conducted outbreak surveillance in some provinces using an existing DEWS. Severe flooding in July and August of 2010 resulted in >1,700 deaths, damaged or destroyed 1.9 million homes, and left at least 10 million people without shelter. This led to the largest international appeal ever (USD 2 billion globally) for humanitarian assistance and a need for an expanded DEWS (*2*).

Postflood Implementation of DEWS

After flooding began, DEWS was expanded to a national system covering all flood-affected districts in the country. The primary objective of the system was early outbreak detection and control (Table 1). Disease reporting through this system began in July 2010. In August 2010, WHO requested CDC assistance to strengthen DEWS. Operational guides with standardized case definitions and reporting forms were distributed (*3*), and national and provincial surveillance staff members were trained. Fixed health facilities and mobile clinics in flood-affected areas were expected to report case counts of 13 conditions considered to be epidemic-prone or of public health importance.* Information was compiled daily at the district, provincial, and national levels, and a national epidemiological bulletin showing aggregated data was issued the following day (*4*).

DEWS also included an immediate disease alert and response component to meet its primary objective. Most diseases in DEWS had a defined alert threshold (Table 2) that triggered notification of surveillance staff members and outbreak investigation teams. Laboratory confirmation included onsite rapid diagnostic tests and microbiological testing at the national public health laboratory.

The rapid expansion of DEWS was supported by using surveillance personnel and mechanisms for disease reporting from existing provincial systems. Additional resources from vertical, field-based programs, communicable disease programs, and other health programs also were widely used. Lastly, provincial health

departments actively supported DEWS implementation by facilitating the training of surveillance officers and mandating disease reporting from district health officers.

Surveillance Results

Daily reporting began on July 29, 2010. The average weekly number of reporting sites fluctuated between 958 and 1,948 sites for the first 6 weeks. By mid-September 2010, DEWS covered 81 (67.5%) flood-affected districts of the country's 120 districts.

During July 29–September 15, 2010, a total of 5,618,902 patient visits were reported to DEWS. Of those, 2,174,368 (38.7%) were for a reportable condition, primarily including 850,292 (15.1%) visits for acute respiratory infection, 745,532 (13.3%) for acute diarrhea, and 327,453 (5.8%) for unexplained fever. In some areas, data on additional conditions were collected using nonstandardized forms and included skin diseases, dog bites, snake bites, eye and ear infections, injuries, and heat stroke. Of these, skin diseases were the most commonly reported, with 1,029,942 (18.3% of total) visits.

In the same period, 130 outbreak alerts were generated, of which 115 (88.5%) were for AWD. Another seven (5.4%) disease alerts were for suspected measles, two (1.5%) were for acute flaccid paralysis, and two (1.5%) were for suspected meningitis. Of the AWD alerts, 82 (71.3%) had at least one microbiological sample submitted, with 55 (67.1%) of these samples testing positive for *Vibrio cholerae*. None of the cases of suspected measles, acute flaccid paralysis, or suspected meningitis were laboratory confirmed as measles, polio, or bacterial meningitis.

Reporting Challenges

During its rapid implementation, DEWS encountered several challenges common to disease early warning systems established during disasters (*5,6*). First, application of nonstandard case definitions varied. For example, in Punjab, 311,882 patients with suspected malaria were recorded as having unexplained fever and only 772 confirmed cases were reported as suspected malaria. In contrast, in Sindh, suspected and confirmed malaria cases both were reported as suspected malaria (n = 168,302). This affected national estimates. Disease misclassification made the aggregated national data inadequate for identifying and monitoring disease trends.

Second, acceptance of standardized reporting forms varied because some diseases considered important by provincial authorities were not specifically included on DEWS forms (e.g., skin diseases). Hence, provinces used nonstandard forms, which led to the reporting of multiple disease categories inconsistent with standardized DEWS case definitions. A prominent example was diarrhea. In practice, diarrhea was captured as acute diarrhea, bloody diarrhea, AWD, suspected cholera, gastroenteritis, or other diarrhea, depending on the reporting location.

Third, data rarely were analyzed at the district level or lower because staff members were fully occupied fulfilling daily reporting requirements. Data were analyzed and reported nationally, but most outbreak alerts were based on reports of small numbers of cases reported immediately by telephone or e-mail at the local level.

Fourth, disease reporting was difficult to monitor. Lack of reliable information on functioning health facilities and their catchment populations made it difficult to determine timeliness and coverage. Sites reporting fluctuated daily and late or missing reports were difficult to track because hundreds of sites reported daily. Although DEWS covered most government health facilities, not all partners delivering health services (e.g., nongovernmental organizations) participated in the system. Data were analyzed using proportionate morbidity and case counts, but with uneven reporting, trends reported in epidemiological bulletins were of limited usefulness.

Recent Situation

In 2011 and 2012, Pakistan again experienced heavy monsoon flooding, which affected >4 million persons each year (*7,8*). National DEWS continued to operate with weekly reporting and captured 45,510,570 patient visits and 5,752 disease outbreak alerts in 2011 (*4*). Weekly bulletins were expanded to include subnational trends and outbreak investigation results. Despite early challenges, DEWS remained important for outbreak detection in the absence of other outbreak detection systems.

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Editorial Note

This report describes the implementation of a postdisaster DEWS in Pakistan. The challenges of DEWS implementation mirror those of other early warning alert and response network (EWARN) surveillance systems, which have been documented in many emergencies, including Sudan, Darfur, Haiti, and Pakistan, and discussed at two WHO technical workshops (*9,10*).

The primary objective of an EWARN system is early detection of and response to epidemic-prone diseases. In a major emergency, EWARN systems should be implemented expeditiously and should focus on that objective. Alerts of typically rarer diseases should trigger timely investigation and control measures. In practice, however, EWARN systems frequently include monitoring of other infectious diseases of public health importance, that occur more frequently, as they did in Pakistan. This is problematic because reporting of these more common diseases can overwhelm resources, negatively affect data quality, and potentially detract from outbreak detection.

Existing nonemergency surveillance systems can be used to capture information on the more common diseases, or reporting from select sentinel sites might suffice to assess trends. In this case, reporting sites should be chosen based on reliability of reporting, representativeness, and other factors that maximize data quality and the ability to respond in a timely manner.

Implementation and coordination of EWARN systems must be improved. Data collection forms with standardized case definitions should be developed in consultation with local partners to maximize acceptance and should be widely distributed in paper form and electronically. Systems should be designed to include available technologies (e.g., short message service data collection), but also have contingency plans should infrastructure fail. Multiple training sessions are required because of high staff turnover in emergencies. Local staff members should be trained to enter and analyze data and receive frequent feedback, so they can use the information they report for public health action and appreciate the benefits of reporting.

In 2010, DEWS exemplified the value and challenges of early warning disease surveillance, and it was a functional system despite the massive scope of the emergency. In 2012, WHO released updated operational guidelines on EWARN implementation, based on evidence gained from prior implementations in Pakistan and other countries (*1*). These guidelines target many of the documented challenges of EWARN implementation. Further evaluations are needed to determine whether adherence to new guidelines results in improvements in the quality and usefulness of surveillance data.

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* The 13 conditions listed in the guidelines included acute watery diarrhea, bloody diarrhea, acute respiratory infection, suspected malaria, suspected measles, suspected meningitis, acute flaccid paralysis, acute hemorrhagic fever syndrome, acute jaundice syndrome, unexplained fever, unexplained disease occurring in a cluster, other diarrhea, and all other conditions.

What is already known on this topic?

After severe flooding in Pakistan in 2010, a large-scale early warning disease surveillance system was implemented. Such systems encounter recurrent challenges in postdisaster settings.

What is added by this report?

A national disease early warning system (DEWS) was implemented expeditiously, and during July 29–September 15, 2010, the system captured information from 5,618,902 patient visits and generated 130 outbreak alerts. DEWS was useful for identifying outbreaks, but was limited by poor data quality during initial implementation.

What are the implications for public health practice?

DEWS in Pakistan collected key information on epidemic-prone diseases but experienced challenges with data quality and system usefulness that are well-documented from prior emergencies. Adherence to recently updated World Health Organization guidelines is critical, and ongoing evaluation of the impact of these new guidelines is needed in future emergencies.

TABLE 1. Categories of diseases commonly included in early warning disease surveillance systems, by attributes

Attribute	Epidemic-prone diseases	Other diseases of public health importance

Objective	Early outbreak detection and response	Monitoring of disease trends
Disease characteristics	Epidemic potential, potential for severe morbidity or mortality, easy and reliable case identification, available treatment and prevention and control measures	Cause high morbidity, easy case identification, necessary for program planning
Typical diseases	Acute flaccid paralysis, cholera, measles, bacterial meningitis	Acute respiratory infection, suspected malaria, acute nonbloody and nonwatery diarrhea
Frequency of reporting	Immediate	Less frequent
Coverage	Universal	Sentinel
Reporting methods	Flexible (e.g., phone, fax, short message service, e-mail)	Designated (e.g., paper, fax, e-mail)
Threshold for investigation	Predefined case count threshold	Observed trends related to baseline
Data reporting requirements	Minimal	Moderate–high

TABLE 2. Disease Early Warning System priority conditions, alert criteria, number of cases, and disease alerts — Pakistan, July 29–September 15, 2010*

Disease	Case definition	Alert criteria	Action suggested	Total visits (N = 5,618,902)		Disease alerts (N = 130)	
				No.	(%)	No.	(%)
Diseases requiring notification and investigation							
Acute watery diarrhea (suspected cholera)	In an area where cholera is not known to be present: A person aged >5 years with severe dehydration or death from acute watery diarrhea with or without vomiting In an area where there is a cholera outbreak: A person aged >5 years with acute watery diarrhea with or without vomiting *To confirm a case of cholera*: Isolation of *Vibrio cholerae* O1 or O139 from a stool sample	One suspected case	Reinforce appropriate case management; initiate investigation	745,532†	(13.3%)	115	(88.5%)
Bloody diarrhea	Acute diarrhea with visible blood in the stool *To confirm a case of epidemic bacillary dysentery*: Take a stool specimen for culture and blood for serology; isolation of *Shigella dysenteriae* type 1	Three or more cases in one location	Reinforce appropriate case management, including antibiotic usage; collect stool for	49,304	(0.9%)	1	(0.8%)

			culture and antimicrobial sensitivity; initiate investigation				
Acute respiratory infection	Cough or difficulty breathing and breathing 50 or more times per minute for infants aged 2 months to 1 year / breathing ≥40 or more times per minute for children aged 1–5 years, and no chest indrawing, no stridor, no general danger signs§ *Note*: Severe pneumonia = cough or difficulty breathing and one or more of the following (inability to drink or breastfeed, severe vomiting, convulsions, lethargy or unconsciousness) or chest indrawing or stridor in an otherwise calm child	Twice the average number of cases seen in the previous 3 weeks for a given location	Reinforce appropriate case management; initiate investigation	850,292	(15.1%)	0	—
Suspected malaria	Current fever or history of fever within the past 48 hours (with or without other symptoms such as nausea, vomiting and diarrhea, headache, back pain, chills, muscle pain) *To confirm a case of malaria*: Positive laboratory test for malaria parasites (blood film [thick or thin smear] or rapid diagnostic test) *Uncomplicated malaria*: Fever and no general danger signs such as lethargy or unconsciousness, convulsions, or inability to eat or drink. Where possible confirm malaria with laboratory test *Severe malaria*: Fever and general danger signs (lethargy or unconsciousness, convulsions, or inability to eat or drink)	Twice the mean number of cases seen in the previous 3 weeks for a given location	Active fever finding and specimen collection for laboratory confirmation	201,525	(3.6%)	1	(0.8%)
Suspected measles	Fever and maculopapular rash (i.e., nonvesicular) and cough, coryza (i.e., runny nose) or conjunctivitis (i.e., red eyes) or any person in whom a clinical health worker suspects measles infection *To confirm a case of measles*: Presence of measles-specific immunoglobulin M	One case	Immediate investigation and active case finding in coordination with the national immunization program	60	(<0.1%)	7	(5.4%)

TABLE 2. (*Continued*) Disease Early Warning System priority conditions, alert criteria, number of cases, and disease alerts — Pakistan, July 29–September 15, 2010*

Disease	Case definition	Alert criteria	Action suggested	Total visits (N = 5,618,902)		Disease alerts (N = 130)	
				No.	(%)	No.	(%)
Diseases requiring notification and investigation							
Suspected meningitis	Sudden onset of fever (>101.3°F [>38.5°C]) with stiff neck. In patients aged <12 months, a suspected case of meningitis occurs when fever is accompanied by a bulging fontanelle *Probable case of bacterial meningitis*: Suspected case of acute meningitis, as defined above, with turbid cerebrospinal fluid (CSF) *Probable case of meningococcal meningitis*: Suspected case of acute meningitis, as defined above, and Gram stain showing gram-negative diplococcus or ongoing epidemic or petechial or purpural rash *To confirm a case of meningococcal meningitis*: Suspected case, as defined above, with either positive-CSF antigen detection for *Neisseria meningitidis* or positive CSF or blood culture with identification of *N. meningitidis*	One case	Reinforce appropriate case management; initiate investigation	4	(<0.1%)	2	(1.5%)
Acute flaccid paralysis (suspected poliomyelitis)	Acute flaccid paralysis in a child aged <15 years, including Guillain-Barre syndrome, or any acute paralytic illness in a person of any age in whom poliomyelitis is suspected	One suspected case	Case investigation and specimen collection for laboratory diagnosis	9	(<0.1%)	2	(1.5%)
Acute hemorrhagic fever syndrome	Acute onset of fever (duration of <3 weeks) and any of the following: hemorrhagic or purpuric rash, vomiting with blood, cough with blood, blood in stools, epistaxis, other hemorrhagic symptoms		Initiate verification and investigation as required	0		1	(0.8%)

Acute jaundice syndrome	Illness with acute onset of jaundice and absence of any known precipitating factors and/or fever	Three of more cases in one location	Initiate verification and investigation as required. Specimen collection for laboratory confirmation	189	(<0.1%)	0	—
Unexplained fever	Fever (body temperature >101.3°F [>38.5°C]) for >48 hours and without other known etiology	One death or two times the mean number of cases of the previous 3 weeks for a given location	Initiate investigation	327,453	(5.8%)	0	—
Unknown disease occurring in cluster	An aggregation of cases with similar symptoms and signs of unknown cause that are closely grouped in time and/or place	An aggregation of cases with related symptoms and signs of unknown cause that are closely grouped in time and/or place	Initiate verification and investigation as required	0		0	—

TABLE 2. (*Continued*) Disease Early Warning System priority conditions, alert criteria, number of cases, and disease alerts — Pakistan, July 29–September 15, 2010*

Disease	Case definition	Alert criteria	Action suggested	Total visits (N = 5,618,902)		Disease alerts (N = 130)	
				No.	(%)	No.	(%)
Other diseases of public health importance							
Other diarrhea	Acute diarrhea (passage of three or more loose stools in the past 24 hours) with or without dehydration, and which is not because of bloody or watery diarrhea			745,532†	(13.3%)	—	—
Other diseases	Including skin diseases, dog bites, snake bites, eye and ear infections, injuries, heat stroke, and other diseases			3,444,534	(61.3%)	1	(0.8%)¶

* Source: Outbreak surveillance and response, disease early warning system, flooding response in Pakistan, operational guidance, August 2010. Available at http://www.who.int/hac/crises/pak/pakistan_operational_guidance_flooding_august2010.pdf .

† Diarrhea was reported as acute diarrhea, which included acute watery diarrhea and other diarrhea.

§ Not specified.

¶ Leishmaniasis.

Page last reviewed: December 14, 2012
Page last updated: December 14, 2012
Content source: Centers for Disease Control and Prevention

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